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Editors

Handbook of Digital Games and Entertainment Technologies

SpringerReference

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Volume 1

With 373 Figures and 36 Tables

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Preface

We are very proud of presenting to the reader this Springer *Handbook of Digital Games and Entertainment Technologies*.

The Handbook covers all aspects of designing and building the most advanced interactive systems and devices for playing and entertaining, such as human-machine interfaces, networks and robots, artificial intelligence, and interactive television, and includes interdisciplinary studies on serious games, digital art, edutainment, entertainment ethics and sociology, and many more. The scope of each part spans from basic theories to enabling technologies, and from advanced applications to psychological and sociological reflections on those.

Entertainment is an essential part of our everyday activities. When we are children we play with our friends and listen to stories told by our relatives: these experiences are the basis of our ability to communicate, discuss, and negotiate with others. Johan Huizinga showed in his book *Homo Ludens* that playing is the basis of our culture. In the course of the human history, however, somehow entertainment has been thought as a marginal activity of lesser importance with respect to other activities such as education, work, medicine, etc.

Thanks to the development of digital information and communication technologies (ICT), recently a plethora of new and interactive entertainment systems and products have emerged: from lean-back consumption to lean-forward interaction. Not only the younger generations but also more mature generations enjoy playing video games, communicating via social networks, and using new enhanced entertainment media like interactive television or immersive virtual reality systems. These new systems and products are blurring the distinction between work and play just as the psychologist Mihaly Csikszentmihalyi indicated in his "Flow Theory."

The entertainment market is huge; the companies offering products in the areas of playing consoles, smart toys, online games, digital music, interactive TVs, movies, robots, etc., are economically very relevant. However, until recently entertainment was not considered as a major research topic in academia. In the first decade of the current twenty-first century, some pioneering researchers including us working in the area of entertainment met several times in specific conferences and agreed to define a new research area called "entertainment computing." In this new area, we wanted to get together various types of interdisciplinary research. We asked the International Federation on Information Processing (IFIP) to setup a new technical committee

focusing on entertainment computing. In 2002, our proposal was accepted and we formed a new group called Specialist Group on Entertainment Computing that in 2006 was upgraded to Technical Committee on Entertainment Computing (IFIP TC14). Members of TC14 have been working in various areas of entertainment computing and have been promoting academic activities in this area.

Today, the design of digital games exploiting entertainment technologies has been recognized as an important and attractive topic in academic research. There are many people both in academia and industry who want to know the most recent topics and developments. Therefore we accepted the invitation by Springer to edit this Handbook. We hope that this work will contribute to a prospering development of entertainment computing both in academia and industry.

The aim of this Handbook is to serve as a key reference work as it provides the readers with a holistic picture of this interdisciplinary field covering technical issues, aesthetic/design theories, and sociological investigations. The Handbook consists of invited contributions from top class scholars and researchers from several topic areas. Each author was assigned the task to recall the foundations of a specific subject in the field of entertainment computing, to survey the current state of the art in the same field, and finally to sketch the most advanced entertainment applications related to that field.

The parts and their editors are the following:

1. Artificial Intelligence and Games (part editor Paolo Ciancarini): Artificial intelligence is a fundamental enabling technology for improving the playing experience in several types of games. This part includes four chapters dealing with algorithms and technologies for solving games, especially based on machine learning from large sets of playing data.
2. Brain-Computer Interfaces and Games (part editor Anton Nijholt): The direct exploitation of the brain activities of players is a radically new way to interact with entertainment products. This part includes six chapters describing how special devices allow to play in novel ways and how they influence the design of new videogames.
3. Entertainment Games (part editor Junichi Hoshino): Digital games are the core of entertainment computing. This part includes four chapters on different types of videogames exploiting a variety of entertainment computing technologies. Especially a survey on digital game industry would give readers the latest and deep insight into this fast moving area.
4. Interactive Storytelling (part editors Marc Cavazza and Michael Young): Storytelling is a very ancient activity; interactive storytelling is based on software which supports a narrative whose storyline is not predetermined. Interactive storytelling fulfills an old dream: the ability of the listener to “enter” the story she is told. This part includes five chapters which display a very interdisciplinary panorama on this subject.
5. Networking in Games (part editor Marco Roccetti): The global availability of the Internet and the widespread diffusion of powerful smartphones and personal

computers allow millions of people to play anytime everywhere, alone or in very large parties. Entertainment systems need advanced network technologies which connect devices with very different capabilities. This part includes five chapters on the main issues in networking for entertainment.

6. Serious Games (part editor Alessandro De Gloria): Serious games are one of the most promising areas in bridging the gap between enjoyful play and professional use through gamification. This part includes three chapters on serious gaming regarding science, technology, engineering, and mathematics (STEM); corporate identity; and ethics, privacy, and trust.
7. Art and Entertainment (part editors Ryohei Nakatsu and Naoko Tosa): Entertainment computing is a discipline whose aim is to combine technology with other areas such as art, culture, etc. Digital arts are novel forms of expression that we are learning to appreciate. This part includes seven chapters showing various examples on how entertainment computing handle art and culture.
8. Edutainment (part editor Wolfgang Mueller): The combination of edutainment and entertainment technologies – sometimes called "gamification" – offers new possibilities to educators and learners. This part includes two chapters.
9. Entertainment Robots (part editors Hooman Samani and Elham Saadatian): Robots are just starting to coexist with humans in several fields. Playful robotic devices offer new challenges in human-machine interactions and enable new kinds of user experiences that need to be studied with special care. This part includes four chapters.
10. Interactive Television and Online Experiences (part editor Marianna Obrist): Digital technologies enable new ways of interacting with old media: interactive TV is one major example, where the viewer is allowed to participate in the TV experience. This part includes five chapters.
11. Social and Ethical Issues (part editor Matthias Rauterberg): Because entertainment products have not only a technical and economical impact but also an enormous societal impact, this part addresses all related topics. This part includes six chapters on social and ethical aspects regarding positive and negative effects, in particular addiction, emerging media technology, and unconscious emotions.

This Handbook is a work in progress (a living reference work in Springer terms). This means that the authors and the part editors are allowed to update the online version of the papers even before the next edition of the Handbook. We are already planning a new edition, to include the new developments and topics that the exciting field of entertainment computing will study in the next future. Therefore, we will invite additional chapters from recognized experts in such fields.

The editors wish to thank all those who contributed to this Handbook, especially all part editors who have collected valuable chapter papers and reviewed them to guarantee the high quality of this Handbook.

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About the Editors

Paolo Ciancarini is Professor of Computer Science at the University of Bologna since 1992.

He got a Ph.D. in Informatics at the University of Pisa in 1988.

In Bologna, he lectures on Software Engineering and Software Architecture, and is member of the Faculty of the PhD School in Computer Science.

He currently is the President of the Italian Association of University Professors in Computer Science.

He is also the Vice-Director of CINI (National Inter-University Consortium for Informatics), a consortium of 43 universities engaged in national and international research projects.

In the period November 2011–June 2013, he has served in the national panel (ANVUR GEV01) for the evaluation of computer science research in Italian universities and research centers (VQR 2004–2010).

In the period March 2012–December 2013, he has been a member of the Italian ICT Delegation at the European Union for the 7th ICT Framework Program.

His research interests include: coordination languages and models, software architectures and infrastructures, advanced Web technologies, and software engineering for computer games.

He has been involved as a site leader in several projects funded by the European Commission and by the Italian Government.

He is the author of over 120 scientific papers and books.

He is married, has two children, and is a passionate chess player and book collector.

Prof. Dr. Matthias Rauterberg Eindhoven University of Technology (Netherlands), received a B.S. in Psychology (1978) at the University of Marburg (Germany), a B.A. in Philosophy (1981), a B.S. in Computer Science (1983), an M.S. in Psychology (1981), an M.S. in Computer Science (1986) at the University of Hamburg (Germany), and a Ph.D. in Computer Science/Mathematics (1995) at the University of Zurich (Switzerland). He was a senior lecturer for "usability engineering" in computer science and industrial engineering at the Swiss Federal Institute of Technology (ETH) in Zurich, where later he was heading the Man-Machine Interaction research group (MMI) (1989–1998).

Since 1998, he is Fulltime Professor for "Interactive Systems Design" first at IPO – Centre for User System Interaction Research, and later at the Department of Industrial Design at the Eindhoven University of Technology (TU/e, The Netherlands). From 1999 till 2002, he was director of IPO. He was director of the graduate program at the Department of Industrial Design of the TU/e (2012–2014). He was the head of the Designed Intelligence research group (2006–2015). He was the Swiss representative in the IFIP TC13 on "Human Computer Interaction" (1994–2002) and the chairman of the IFIP WG13.1 on "HCI and Education" (1998–2004). He is now the Dutch representative in the IFIP TC14 on "Entertainment Computing" and the founding vice-chair of this TC14 (2006–2012). Since 2012, he is the IFIP TC14 chair (2013–2015). He was appointed as visiting professor at Kwansei Gakuin University (Japan) (2004–2007); he is senior honorary research fellow of Taicang University Science and Technology Park (since 2012) and guest professor at Jiangnan University (Wuxi, China) (2011–2015) and at East China University of Science and Technology (Shanghai, China) (2013–2016).

He received the German GI-HCI Award for the best Ph.D. in 1997 and the Swiss Technology Award for the BUILD-IT system in 1998. In 2004, he was nominated as member of the "Cream of Science" in the Netherlands (the 200 top-level Dutch researchers) and among the 10 top-level TU/e scientists. Since 2007, he is holder of the IFIP Silver Core Award.

He has over 400 publications in international journals, conference proceedings, books, etc. He acted also as editor and member of the editorial board of several leading international journals. Since 2009, he is co-editor-in-chief of the journal *Entertainment Computing* (Elsevier). He acts regularly as reviewer for national and international funding bodies, individual selection and departmental assessments committees, and large-scale European funding schemas. He was appointed as member of one of the few expert and evaluation panels for the most esteemed European grant from the European Research Council (2010–2014).

Ryohei Nakatsu received the B.S., M.S., and Ph.D. degrees in Electronic Engineering from Kyoto University in 1969, 1971, and 1982, respectively. After joining NTT in 1971, he mainly worked on speech recognition technology. In 1994, he joined ATR (Advanced Telecommunications Research Institute) as Director of ATR Media Integration and Communications Research Laboratories. In 2002, he became Professor at School of Science and Technology, Kwansei Gakuin University. Since March 2008 until December 2014, he was Professor at National University of Singapore (NUS) and was Director of Interactive and Digital Media Institute (IDMI) at NUS. In December 2014, he retired from NUS and came back to Japan. Now he is Adjunct Professor of Kyoto University, Kyoto/Japan, and Visiting Professor of Seika University, Kyoto/Japan. Also he has established two start-up companies and now he is serving as CEO of Hexogon Japan and Executive Director of NT & Associates.

His research interests include interactive media, entertainment technologies, and communication robot/agent.

In 1978, he received Young Engineer Award from the Institute of Electronics, Information and Communication Engineers Japan (IEICE-J), in 1996 the best paper award from the IEEE International Conference on Multimedia, in 1999, 2000, and 2001, Telecom System Award from Telecommunication System Foundation and the best paper award from Virtual Reality Society of Japan, and in 2000 the best paper award from Japanese Society for Artificial Intelligence. Also he received in 2010 IEEE Kansai Section medal, in 2011 IEEE Virtual Reality Service Award, and in 2012 IFIP TC14 Contribution Award.

He is a fellow of the IEEE since 2001 and a life fellow since 2014. Also he is a fellow of the Institute of Electronics, Information and Communication Engineers Japan (IEICE-J) since 2001 and Virtual Reality Society of Japan since 2012. Also he is a honorary member of Japanese Society for Artificial Intelligence. He is a member of various academic societies such as IEEE, IEICE-J, Japanese Society for Artificial Intelligence, and others. He was a chair of IFIP Technical Committee on Entertainment Computing (TC14) since 2006 until 2012 and now is an honorary member of IFIP TC14.

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